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WEATHER AND CIRCULATION OF OCTOBER 1972

Record October Precipitation in the Southwest

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1. MEAN CIRCULATION

The mean 700-mb circulation for October 1972 was characterized by a highly amplified midlatitude flow pattern from the central Pacific eastward to Europe (figs. 1, 2). Blocking was evident in the Gulf of Alaska and along an axis westward from Scandinavia. In conjunction with the blocking, midlatitude Lows were observed along coastal California and west of Portugal.

Mean height departures fell sharply near the North Pole from September to October (fig. 3) as the blocking ridge that had been over Siberia during September fell away in October. Support for the ridge was lost as the Low to its west moved poleward from its mean September position.

Most midlatitude components of the mean 700-mb flow pattern moved eastward from Septmber to October under the influence of a seasonal strengthening of the zonal westerlies. As a result, a full-latitude trough in the Pacific Ocean extended southward from the Bering Strait, and a blocking ridge developed downstream near 130°–140°W. The aforementioned Low along the coast of California developed when the attendant trough deepened as it moved slightly westward.

The trough accompanying the deep Canadian Low stretched southward over eastern North America during

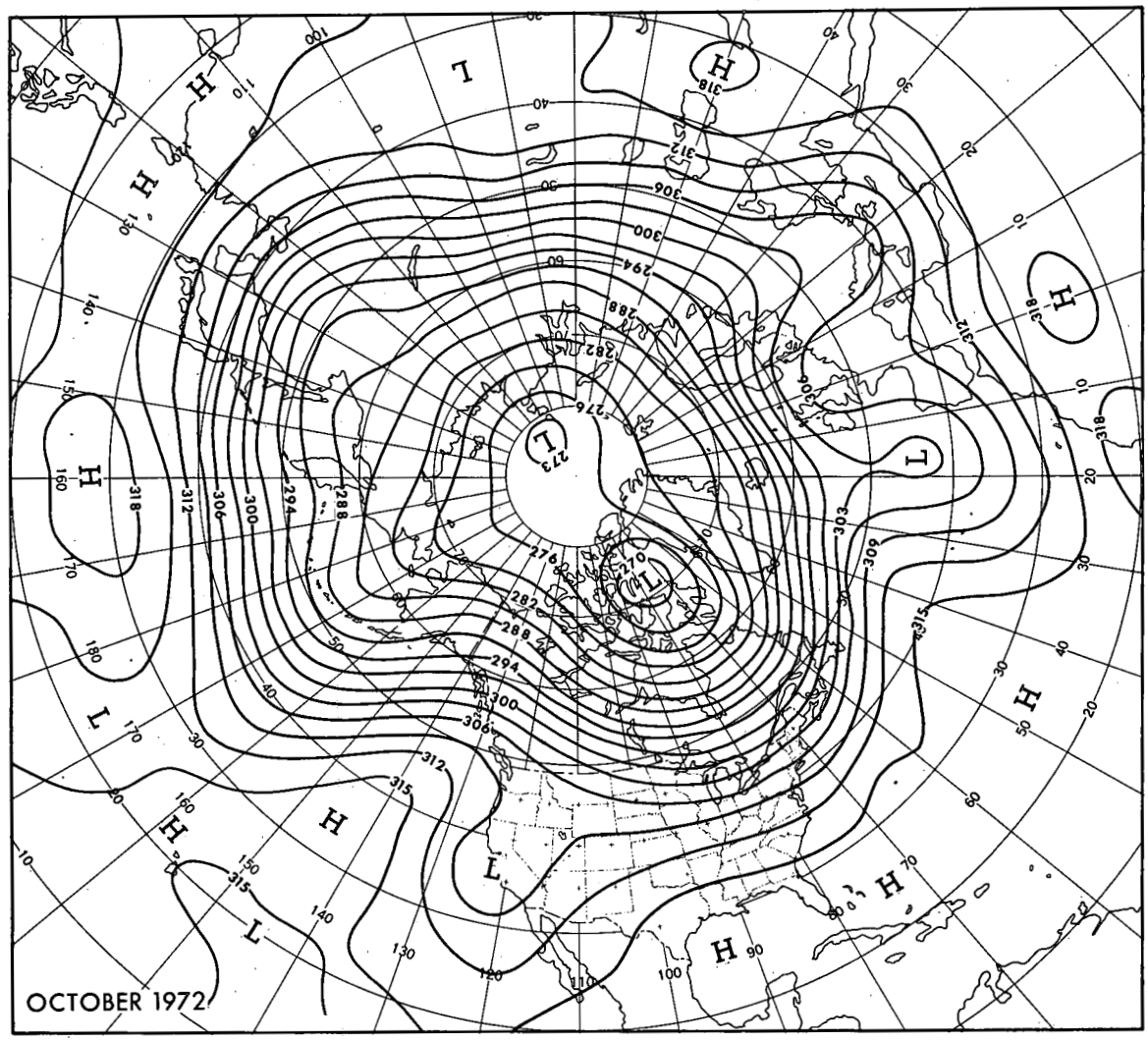


FIGURE 1.—Mean 700-mb contours in dekameters (dam) for October 1972.

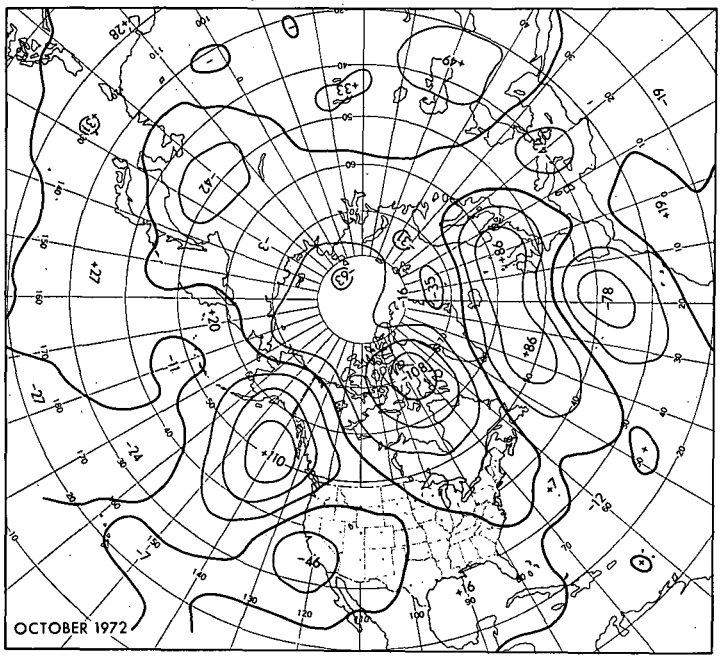


FIGURE 2.—Departure from normal of mean 700-mb height in meters (m) for October 1972.

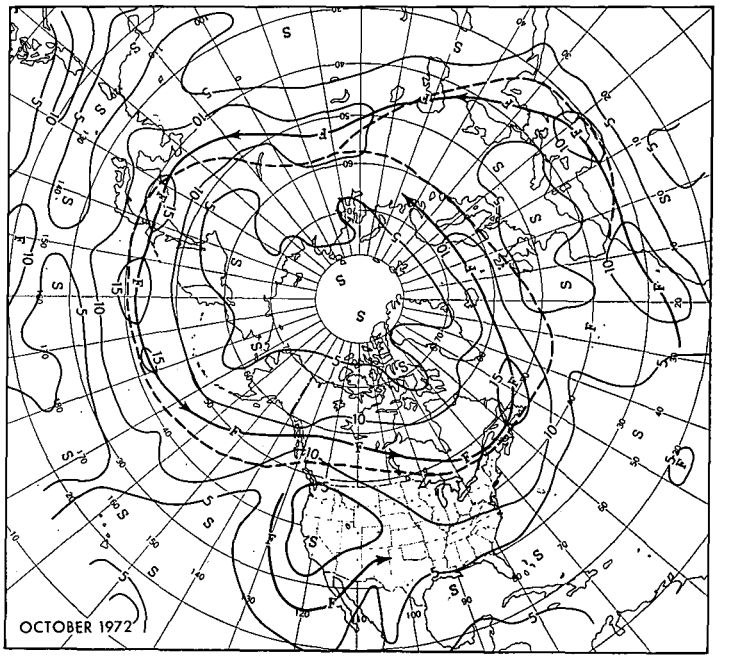


FIGURE 4.—Mean 700-mb geostrophic wind speed (m/s) for October 1972. Solid arrows show the observed axes of maximum wind speed, and dashed lines show the normal.

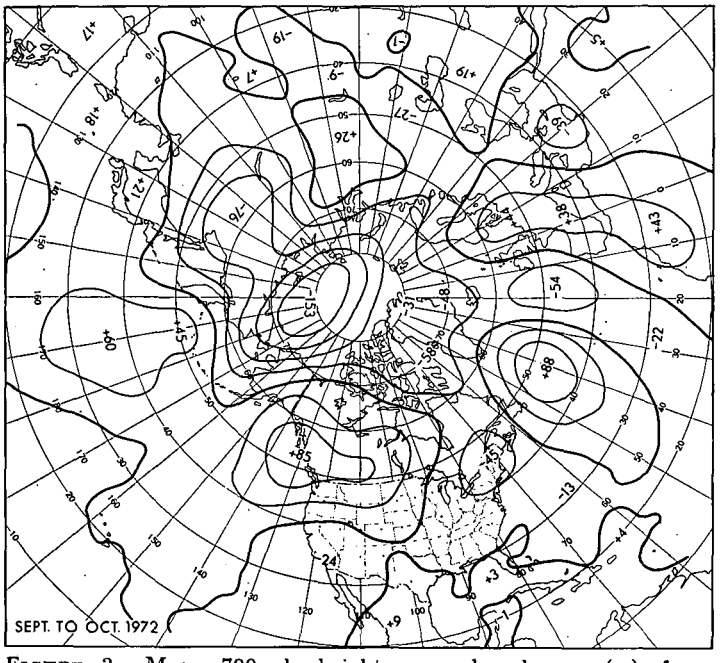


FIGURE 3.—Mean 700-mb height anomaly change (m) from September to October 1972.

TABLE 1.—*Notable mean monthly temperatures observed in October 1972*

Station	Temperature (°F)	Anomaly (°F)	Remarks
Hartford, Conn.	48.9	−4.1	Coldest Oct. in 32 yr
Worcester, Mass.	44.7	−5.8	2d coldest Oct.
Duluth, Minn.	38.9	−5.7	3d coldest Oct.; coldest Oct. since 1925
Minneapolis, Minn.	43.7	−5.2	3d coldest Oct. back to 1890; coldest Oct. since 1925
Norfolk, Nebr.	47.2	−5.7	Coldest Oct. in 41 yr
Omaha, Nebr.	49.1	−6.6	3d coldest Oct. in past 100 yr; coldest Oct. since 1925
Concord, N.H.	42.3	−6.4	2d coldest Oct.; coldest Oct. since 1925
Youngstown, Ohio	46.1	−5.8	Coldest Oct.
Avoca, Pa.	45.3	−5.7	Do.
Providence, R.I.	49.6	−3.7	3d coldest Oct.; coldest Oct. since 1925
Burlington, Vt.	42.4	−5.2	3d coldest Oct.; coldest Oct. since 1925
Olympia, Wash.	46.5	−4.9	Coldest Oct.
Alpena, Mich.	42.4	−3.9	Coldest Oct. since 1925
Detroit, Mich.	47.3	−4.9	Do.
Houghton Lake, Mich.	41.7	−5.3	Do.
Albany, N.Y.	45.7	−5.1	Do.
Cleveland, Ohio	49.1	−4.3	Do.
Erie, Pa.	47.2	−4.2	Do.
Huron, S. Dak.	44.8	−4.0	Do.

October; there was, however, no connection with the trough off the southwest coast as there had been in September (Wagner 1972). Deepening of this trough to the south was aided by several instances of cyclogenesis along the east coast of the United States. A flat ridge remained over most of the southeastern portion of the United States.

From the western Atlantic Ocean to Europe, the flow at midlatitudes was characterized by a short-wave pattern. The trough near Portugal retrograded from its September location in reaction to the amplification upstream.

Over Asia, the mean flow was mostly zonal. A ridge was still located in the region of the Caspian Sea, while, to the east, a deepening trough prevailed from the Sea of Okhotsk to Korea.

The mean 700-mb zonal westerlies for the 35°–55°N band across the western half of the Northern Hemisphere averaged about 1 m/s slower than normal. Polar westerlies (55°–70°N) were about 2 m/s faster than normal, however. This corresponded with a northward displacement of the axis of the mean 700-mb jet (fig. 4).

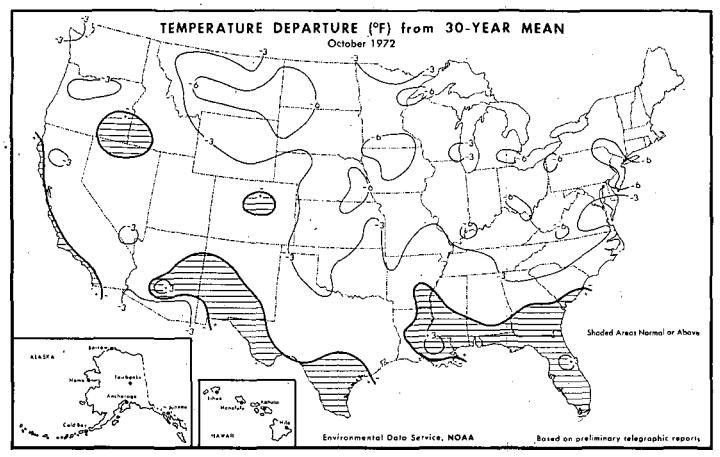


FIGURE 5.—Departure from normal of average surface temperature (°F) for October 1972 (from Environmental Data Service and Statistical Reporting Service 1972).

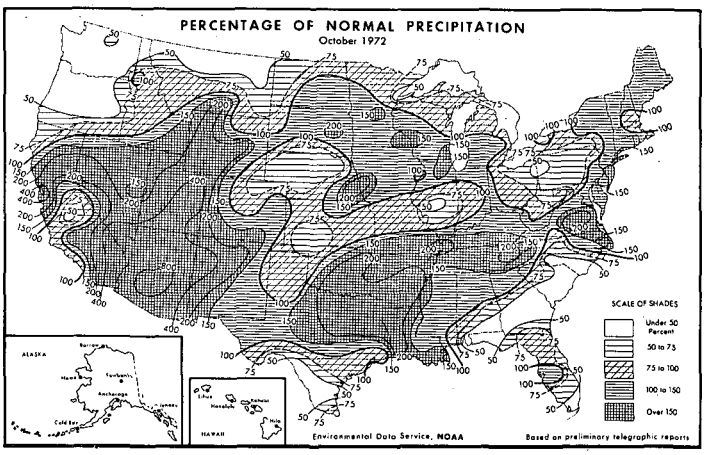


FIGURE 6.—Percentage of normal precipitation for October 1972 (from Environmental Data Service and Statistical Reporting Service 1972).

2. TEMPERATURE

Mean surface temperatures averaged below normal over most of the Nation during October 1972 (fig. 5). In fact, this month was one of the coldest, if not the coldest, Octobers on record at a number of stations (table 1). In general, this October was the coldest such month since 1925.

The abnormally low mean temperatures were associated with the unusually strong northwesterly winds at 700 mb. This mean flow transported surges of arctic air southeastward into the Nation with enough vigor that, for the most part, only the extreme southern portions of the country had above-normal temperatures.

In contrast to the conterminous United States, much of Alaska had above-normal temperatures in response to the close proximity of the strong mean 700-mb ridge. Stations along the southern border of the State, however, recorded temperatures that averaged below normal for the month. Mean temperatures in the Hawaiian Islands were generally about 1°F higher than normal.

3. PRECIPITATION

Precipitation for October 1972 was up to eight times the normal in the Southwest and more than twice the normal in portions of the Southern Plains and the lower Mississippi Valley (fig. 6). Much of this precipitation can be attributed to the effects of the mean 700-mb trough near California. Southerly flow to the east of the trough brought moisture-laden Pacific air over a large part of the Southwest, resulting in record October rainfall, especially in Arizona (table 2). Later in the month, low-latitude impulses from the trough moved eastward in sufficient strength to tap the moist Gulf of Mexico air, with resultant heavy rains in the mid-South.

Mean northwesterly winds aloft helped to deter precipitation in the Northwest while a persistent ridge kept southern Texas and part of the Southeast unusually dry.

Several stations reported record snowfall for October (table 2) in conjunction with the below-normal surface temperatures. In addition, a few cities throughout the northern half of the Nation experienced the earliest measurable October snowfall on record.

Precipitation for the month at stations in both Alaska and the Hawaiian Islands was generally near or above the October normal. The nearness of the mean 700-mb trough to the west coast of Alaska brought record October precipitation to Nome.

TABLE 2.—*Notable monthly precipitation amounts observed in October 1972*

Station	Amount (in.)	Anomaly (in.)	Remarks
Nome, Alaska	3.84	+2.13	Wettest Oct.
Pt. Barrow, Alaska	1.40	+0.90	Wettest Oct. since 1925
Flagstaff, Ariz.	9.86	+8.34	Wettest month of 75-yr record
Phoenix, Ariz.	4.40	+3.94	Wettest Oct.
Tucson, Ariz.	4.51	+3.87	Wettest Oct. back to 1867
Winslow, Ariz.	5.61	+4.95	Wettest Oct.
			Already wettest calendar yr
San Francisco, Calif.	5.24	+4.50	2d wettest Oct. back to 1928
Grand Junction, Colo.	3.45	+2.71	Wettest Oct.
			3d wettest month
	5.7	-	Snowiest Oct.
Pueblo, Colo.	12.6	-	Do.
Cairo, Ill.	7.05	+4.17	Wettest Oct. since 1941
Sault Ste. Marie, Mich.	10.1	-	3d snowiest Oct. back to 1888
Kalispell, Mont.	10.6	-	2d snowiest Oct. back to 1900
Trenton, N.J.	2.5	-	Snowiest Oct. back to 1889
Albuquerque, N. Mex.	3.08	+2.33	Wettest Oct. since 1911
Buffalo, N.Y.	3.1	-	Snowiest Oct. since 1917
Bismarck, N. Dak.	5.8	-	Snowiest Oct. since 1946
Milford, Utah	2.61	+1.84	Wettest Oct. since 1946
Wendover, Utah	2.41	+1.95	Wettest Oct. back to 1911
Key West, Fla.	0.74	−5.08	Driest Oct.
Olympia, Wash.	0.85	−4.43	Do.
Charleston, S.C.	0.25	−2.59	Driest Oct. since 1943

4. WEEKLY VARIABILITY

October 2–8

The mean 700-mb circulation over North America during the first full week of October 1972 featured a full-latitude mean trough over midcontinent with ridges near both the east and west coasts (fig. 7A). A mean Low was located south of California, with a weaker Low over the mid-Atlantic coast.

The pattern of mean surface temperature anomaly for the week was ill-defined (fig. 7B). Basically, however, temperatures were below normal over much of the Nation in response to the mean trough at 700 mb. The major exceptions were in the Far West and the Northeast where, under the influence of mean 700-mb ridges, temperatures were generally higher than normal.

Heaviest precipitation occurred in the Southwest and along the middle Atlantic coast (fig. 7C). The rainfall in the Southwest was associated with moisture advected into the region from tropical storm Joanne as she moved northward toward the area. A weak Low, a remnant of the storm, crossed into southern Arizona on the 6th accompanied by heavy showers. At about the same time, a Low began to deepen along the coast of the Carolinas. Easterly winds to the north of the storm brought heavy precipitation to interior portions of Virginia before the Low moved northward along the coast. The heavy rain in Virginia, nearly a foot in some places, caused flooding of the James River at Richmond. The city was still trying to recover from the disastrous floods that accompanied hurricane Agnes in June 1972. Driest areas of the Nation during the week included much of the Northwest as well as a large part of the southcentral section of the Nation.

October 9–15

Waves in the mean 700-mb flow amplified this week, especially in the area from central Asia eastward to North America (fig. 8A). Most components of the midlatitude wave train over the Pacific Ocean retrograded in response to the weakened zonal flow. The mean Low near California moved northwestward, and the ridge to its west backed up. A broad ridge became established downstream over the southern half of the United States. A double-structured trough extended southward from the progressing Canadian Low, with one trough situated along the east coast and the other across Hudson Bay. A ridge moved to the mid-Atlantic Ocean, replacing the mean trough of the prior week.

A combination of southerly flow and a well-entrenched, 700-mb ridge resulted in above-normal temperatures over most of the southwestern half of the Nation (fig. 8B). Temperatures averaged at least 3°F above normal over most of this region with a maximum departure of +9°F in the Southern Plains. The rest of the Nation experienced lower than normal temperatures as three surges of arctic air moved across the northern half of the country during the week.

Precipitation was light or nonexistent over much of the Nation (fig. 8C) in response to the mean ridge aloft. San Francisco, Calif., and the surrounding area, however, experienced locally heavy rain as a result of the northward movement of the 700-mb Low off the coast. Beginning on October 9, measurable precipitation fell at San Francisco on 8 consecutive days, establishing a new October record for the station.

October 16–22

The mean 700-mb circulation amplified downstream from North America during the third week of October,

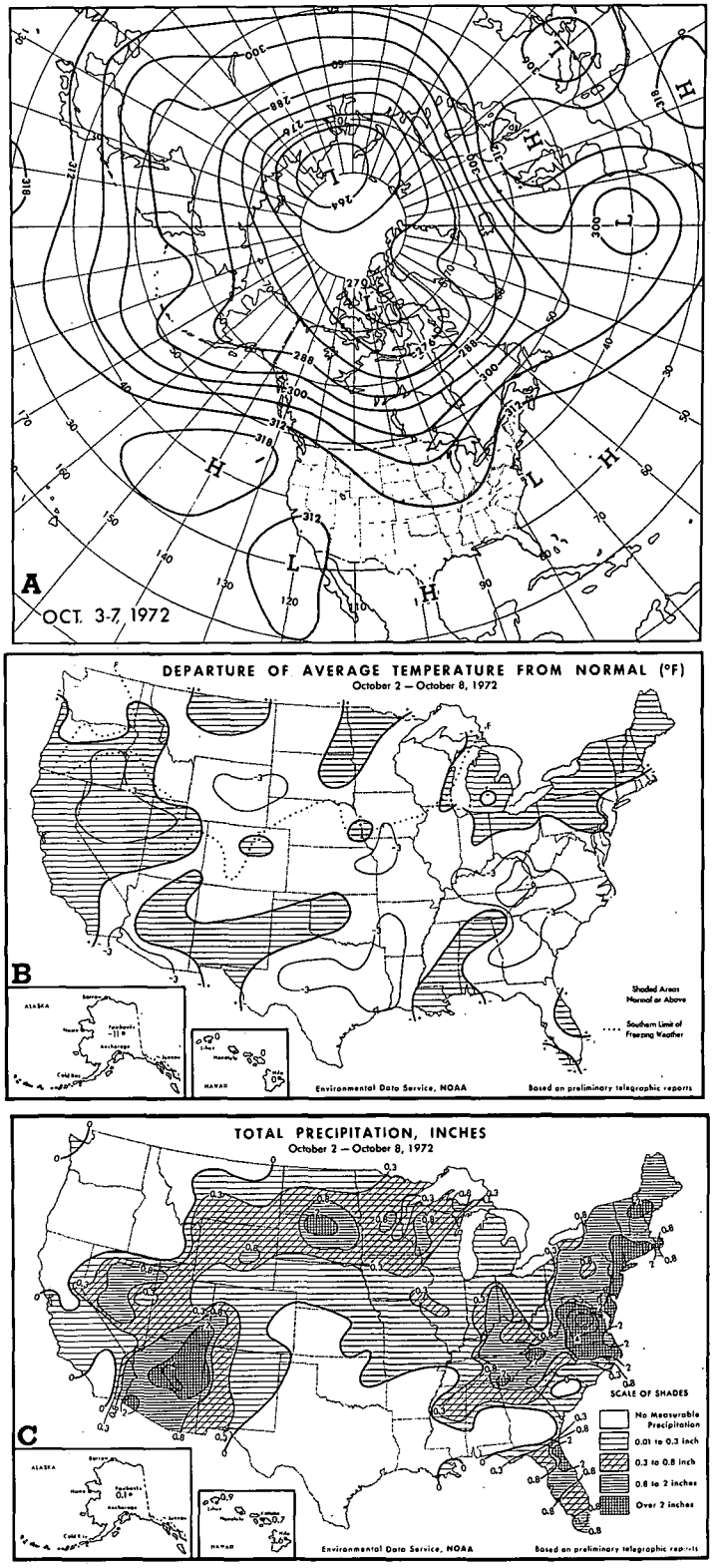
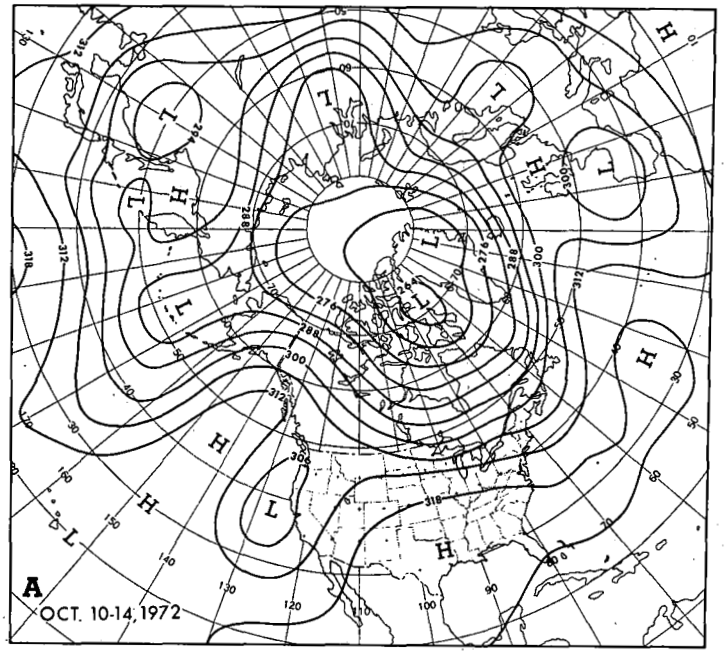
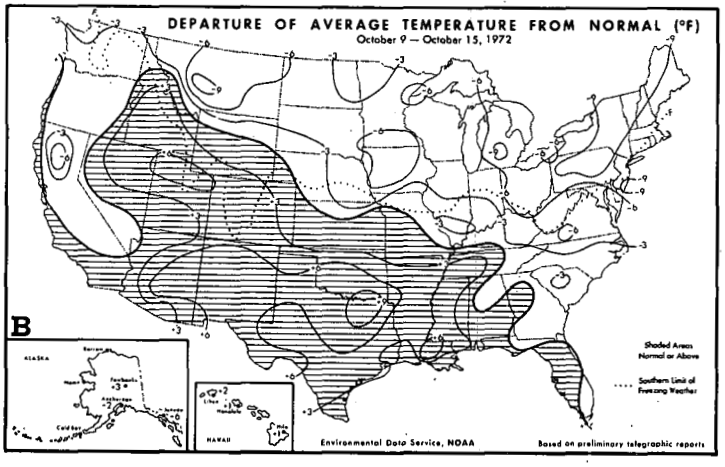


FIGURE 7.—(A) mean 700-mb contours (dam) for Oct. 3–7, 1972; (B) departure from normal of average surface temperature (°F) and (C) total precipitation (in.) for week of Oct. 2–8, 1972 (from Environmental Data Service and Statistical Reporting Service 1972).

while the flow became more zonal in the Pacific (fig. 9A). Although the mean Canadian Low was not as strong this week, the cyclonic flow to the south sharpened into a single trough that reached southward to the Carolina coast. Downstream, the preexisting ridge built northward





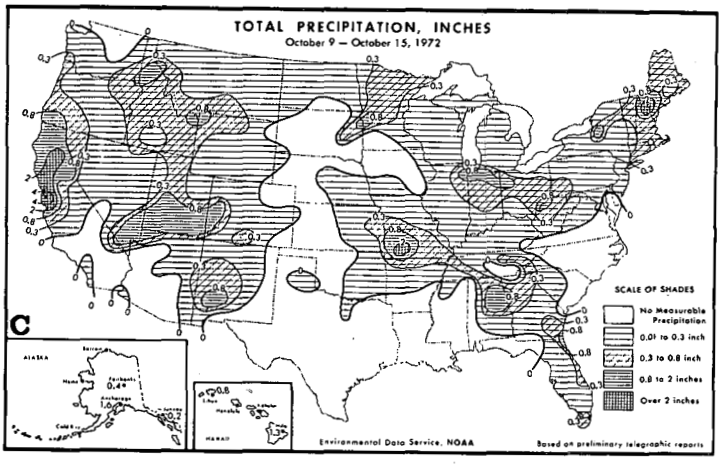
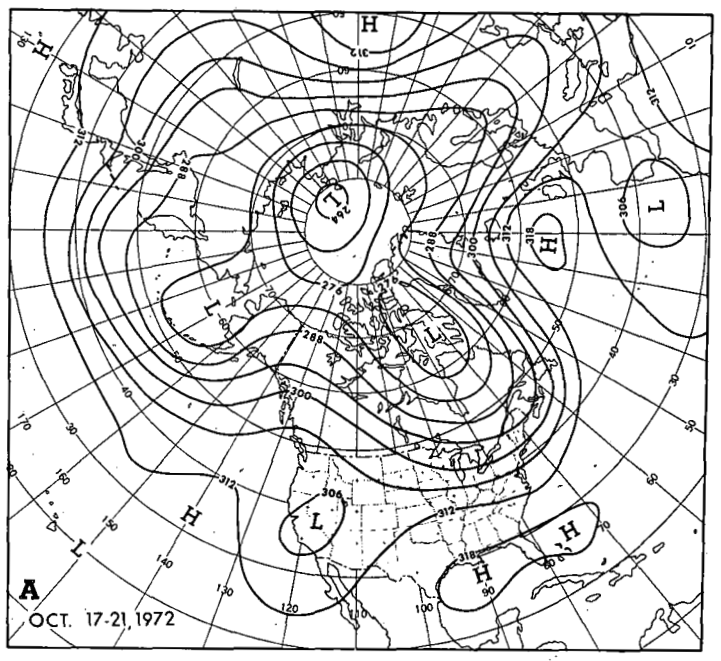
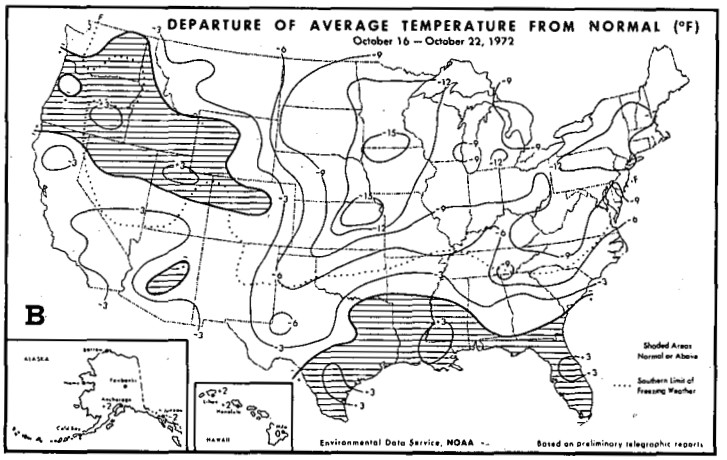


FIGURE 8.—Same as figure 7, (A) for Oct. 10–14, 1972; (B) and (C) for week of Oct. 9–15, 1972.





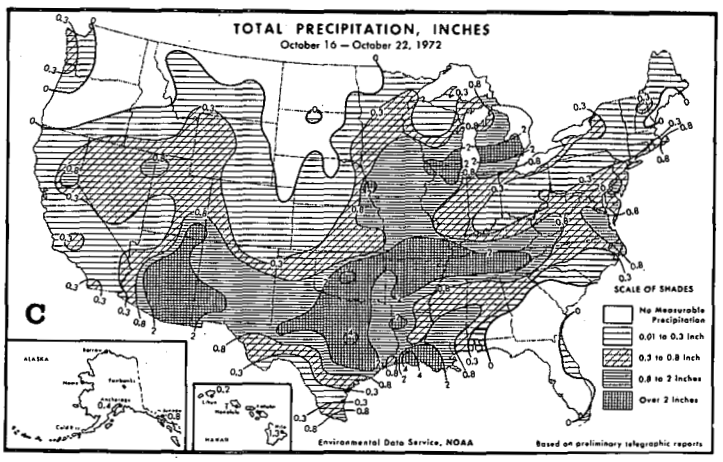


FIGURE 9.—Same as figure 7, (A) for Oct. 17–21, 1972; (B) and (C) for week of Oct. 16–22, 1972.

over Greenland, and a major trough dominated Europe. As the mean 700-mb circulation over the Pacific Ocean flattened, the wave train moved slightly eastward. The higher latitude portion of the North American ridge and the cutoff Low that had been along the California coast moved inland. A weakening ridge persisted over the southeastern quadrant of the country.

Record-breaking arctic air accompanying the intense mean northwesterly flow at 700-mb resulted in lower than normal mean temperatures over most of the Nation (fig. 9B). Surface temperatures averaged more than 9°F below normal over most of the northeastern quarter of the Nation. Above-normal temperatures were evident only in the region from the northwest coast to the Central Rocky

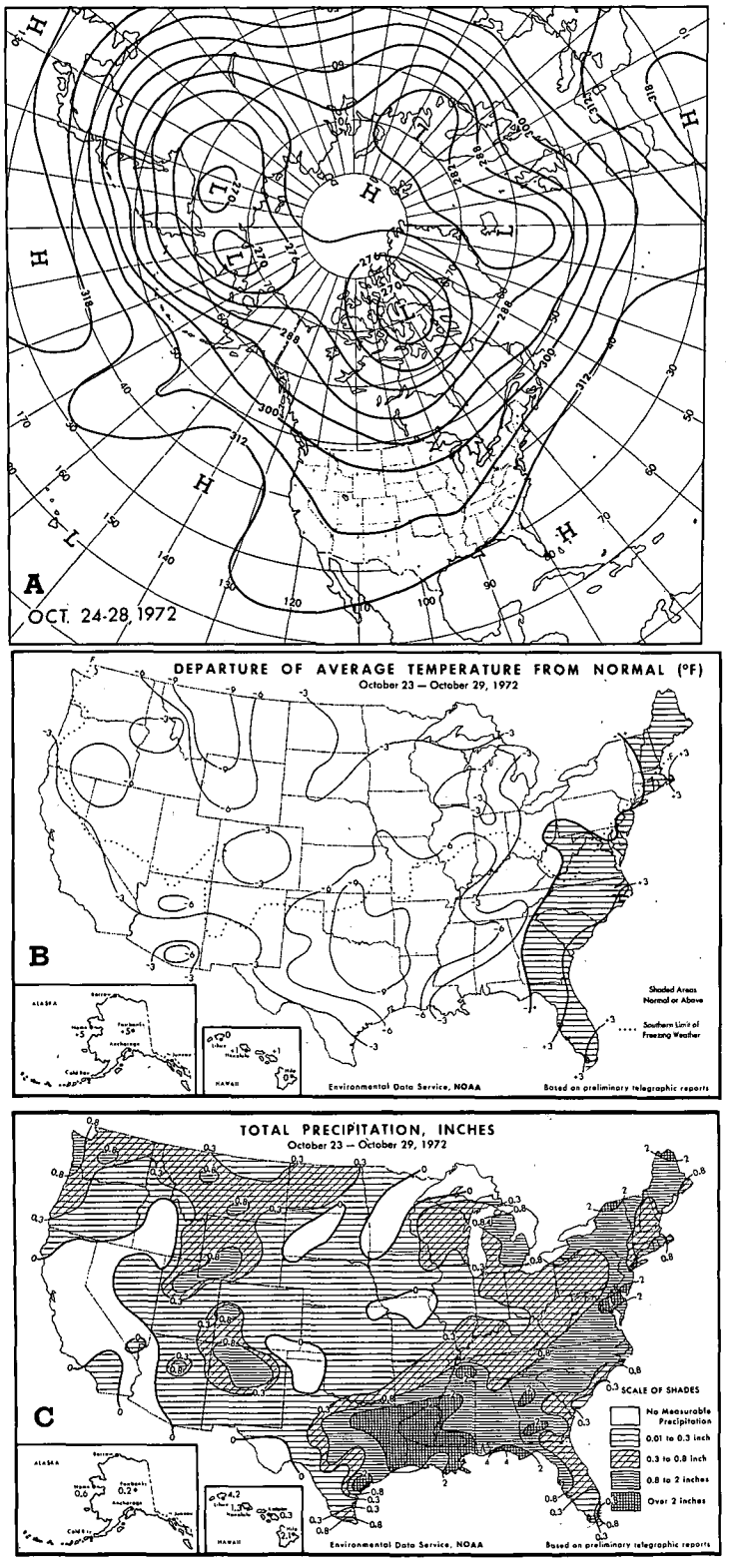


FIGURE 10.—Same as figure 7, (A) for Oct. 24–28, 1972; (B) and (C) for week of Oct. 23–29, 1972.

Mountains and in the vicinity of the gulf coast under the mean ridge.

A cold High began its southward push into the Dakotas on the 17th; and, by the morning of the 21st, the High was centered over New England. Many new record daily minimum temperatures were reported by stations from the Dakotas to the middle and north Atlantic coast during the period of October 18–21. At many of these stations, the temperatures were the lowest ever recorded for so early in the winter season. The lowest October temperatures ever registered were noted at such diverse locations as Sioux Falls, S. Dak. (9°F), on October 19 and Burlington, Vt. (15°F), and Charleston, W. Va. (24°F), on October 20.

Strong warming preceded the passage of the cold front through the South, and several stations had their highest maxima for so late in the season. The highest was at Wichita Falls, Tex., where it was 102°F on the 17th.

Heaviest precipitation occurred in the Southwest and from the previously dry Southern Plains into Tennessee (fig. 9C). Much of this precipitation was associated with a surface system that accompanied a short-wave, 700-mb trough that moved eastward from California and across the South after the middle of the week. Some of the precipitation in the North fell as snow, a somewhat unusual event for mid-October. The earliest measurable snowfalls on record were reported on the 18th or 19th at Allentown, Pa., Providence, R.I., Hartford, Conn., Chicago, Ill., Ft. Wayne, Ind., and Trenton, N.J.

October 23–29

The mean 700-mb circulation for the last full week of October (fig. 10A) exhibited some marked changes from that of the previous week. The full-latitude trough in the Pacific was now located along the Asiatic coast. A mean ridge over the central Pacific, joined with the high-latitude portion of the North American ridge, which had retrograded. The trough over North America was now located over midcontinent and was connected with the progressive Southwest trough.

South of Iceland, mean 700-mb heights dropped more than 300 m as a trough replaced the ridge that moved eastward to Europe. A High became established over the Arctic Ocean north of Asia as the preexisting Low moved southeastward into Siberia.

Under the influence of a broad mean trough at 700 mb, surface temperatures over the Nation averaged well below normal everywhere except along the Atlantic Seaboard (fig. 10B). There, mean southwesterly winds at 700 mb helped to keep surface temperatures higher than normal.

Precipitation during the week (fig. 10C) was greatest in the area of the mean trough over the lower Mississippi Valley. Rainfall totals there exceeded 4 in. in some places. As the month ended, another low-latitude storm system was developing over the Southern Plains, causing heavy rain from northeastern Texas to Illinois.

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